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Pergamon
ADDICTIVE BEHAVIORS
Addictive Behaviors 29 (2004) 207–213

Short communication

Size, consistency, and stability of stage effects for smoking cessation

James O. Prochaska[a,*], Wayne F. Velicer[a], Janice M. Prochaska[b], Janet L. Johnson[b]

[a]*University of Rhode Island, 2 Chafee Road, Kingston, RI 02881, USA*
[b]*Pro-Change Behavior Systems, Incorporated, West Kingston, RI, USA*

Abstract

In the transtheoretical model (TTM), the stage effect is one of the most important determinants of health behavior change. Randomly assigned to 1 of 11 treatment conditions were 4653 smokers. A total of 66 stage effects were possible with 6 for each of the 11 treatment groups. The results suggest that brief stage-matched interventions that help populations progress one stage could produce 75% more abstinence. Interventions that help populations progress two stages could produce 300% more abstinence. The results also support the importance of replicating the stage effects across treatment conditions and over time.

Keywords: Stage effect; Transtheoretical model; Smoking cessation

1. Introduction

In the transtheoretical model (TTM), three effects are assumed to determine outcome: treatment effects, severity effects, and stage effects. With smoking, those who receive treatment should have better effects than those who do not. Those who face more severe consequences for not changing, such as people with cardiovascular disease, should change more. Those who are further along in the stages of change should quit more. This paper focuses on the size, consistency, and stability of stage effects as determinants of outcomes.

In TTM, the stage effect is assumed to be one of the most important determinants of health behavior change. Stage effects occur when people who are in the precontemplation

* Corresponding author. Tel.: +1-401-874-2830; fax: +1-401-874-5560.
E-mail address: jop@uri.edu (J.O. Prochaska).

0306-4603/$ – see front matter © 2003 Elsevier Ltd. All rights reserved.
doi:10.1016/S0306-4603(03)00086-8

stage take less action over time than people in the contemplation stage, who take less action than people in the preparation stage. This study assesses the size, consistency, and stability of stage effects at 6-, 12-, and 18-month follow-ups in a population of 4653 smokers.

Previous research reported stage effects in a large sample of smokers changing on their own, in a large sample of smokers with cardiovascular disease in a clinical trial and in a sample of smokers with head, neck, and throat cancer (Gritz, Car, & Chong, 1992; Ockene et al., 1992; Prochaska, DiClemente, & Norcross, 1992). In a large sample of smokers in California, Farkas et al. (1996) found a stage effect when comparing smokers in precontemplation to those in contemplation but failed to find a similar effect for those in contemplation compared to smokers in the preparation stage. This lack of a full set of stage effects was one of the reasons that Farkas et al. advocated rejecting the TTM in favor of a set of addiction variables for understanding smoking cessation.

These mixed results raise the question as to how consistent are stage effects. A second question has to do with the size of stage effects; how much more quitting will occur in smokers in the preparation stage compared to the contemplation stage and in the contemplation stage compared to the precontemplation stage. A third question addresses the stability of stage effects over time from baseline to 6-, 12-, and 18-month follow-ups.

2. Methods

2.1. Subjects

Randomly assigned to 1 of 11 treatment conditions were 4653 smokers. The overall stage distribution at baseline was 37.9% in precontemplation, 44.8% in contemplation, and 17.3% in preparation. This distribution is comparable to other samples of smokers (Prochaska, Velicer, Fava, Rossi, & Tsoh, 2001; Velicer et al., 1995). The mean age of the sample was 40 years and 55% were female.

2.2. Stage algorithm

The staging algorithm was as follows: precontemplation (PC): not intending to quit in the next six months; contemplation (C): intending to quit in the next 6 months; preparation (P): intending to quit in the next month and quit for at least 24 hours in the last 12 months; action (A): quit in the past 6 months; maintenance (M): quit for more than 6 months.

2.3. Interventions

The 11 interventions are described in two outcome reports (Prochaska, Velicer, Fava, Ruggiero, et al., 2001; Velicer et al., 1999):

1. One mailing of stage-matched manuals covering all stages;
2. One mailing of a manual plus an expert system individualized guide;

3. Two mailings of manuals beginning with current stage and followed by future stages;
4. Manual at baseline and two expert system guides;
5. Three mailings of manuals beginning with current stage and followed by future stages;
6. Manual at baseline and three expert system guides;
7. Six mailings of manuals beginning with current stage and followed by future stages;
8. Manual at baseline and six expert system guides;

Table 1
Point Prevalence × Group × Stage × Time Point

Treatment group	Stage at baseline	Stage percent at baseline	Percent abstinent at each assessment period		
			6	12	18
1. M1	PC	37.6	07.7	05.9	09.1
	C	45.4	09.4	15.2	18.1
	P	17.0	15.4	29.4	27.1
2. Ml R1	PC	37.3	04.3	10.9	13.8
	C	45.7	13.5	20.8	25.4
	P	17.1	28.6	27.3	35.1
3. M2	PC	37.0	04.4	04.0	11.4
	C	46.2	10.6	14.5	15.4
	P	16.9	18.9	15.7	21.7
4. M1 R2	PC	40.7	07.7	09.6	12.4
	C	41.8	12.2	16.4	21.8
	P	17.2	18.4	17.4	31.6
5. M3	PC	33.1	03.0	07.8	08.0
	C	44.3	06.8	10.6	15.4
	P	22.7	17.9	27.5	26
6. M1 R3	PC	39.0	14.0	15.4	18.2
	C	44.8	15.2	22.7	22.9
	P	16.3	26.1	25.6	34.2
7. M6	PC	36.0	07.4	10.3	11.0
	C	44.9	15.6	15.6	19.8
	P	18.8	10.9	19.2	29.6
8. M1 R6	PC	37.0	10.4	10.1	17.1
	C	44.5	09.2	14.7	19.2
	P	18.5	21.4	29.8	28.9
9. M1 R3 C3	PC	37.1	07.6	13.8	14.3
	C	41.0	18.6	26.1	24.0
	P	21.9	32.8	43.1	35.3
10. Ml R3 L3	PC	38.5	08.7	14.1	14.4
	C	44.7	10.5	10.3	11.7
	P	16.8	17.7	23.5	21.6
11. Control	PC	37.1	06.1	04.7	07.5
	C	48.7	13.2	18.2	20.7
	P	14.0	23.3	29.0	31.6

Point prevalence abstinence rate at 6-, 12-, and 18-month time periods by treatment group by baseline stage of change.
M = manuals, R = reports, C = counselor calls, L = lifesign, and the corresponding number indicates the number received.

9. Three expert system guides and three proactive telephone counselor calls;
10. Three expert system guides and a hand-held nicotine fading computer;
11. A no-treatment control group.

2.4. Procedure

A total of 66 stage effects were possible with 6 for each of the 11 treatment groups: PC compared to C and C compared to P at 6, 12, and 18 months.

3. Results

Table 1 presents point prevalence abstinence rates at 6, 12, and 18 months for the 11 treatment groups by baseline stage of change. Table 2 presents the absolute difference

Table 2
The absolute difference in percentage points between precontemplation and contemplation and preparation in the point prevalence rates by treatment group and by time point and the related differences

Treatment group	Stage comparison	Absolute difference in percent points	Percent difference	Absolute difference in percent points	Percent difference	Absolute difference in percent points	Percent difference
		6 mo.		12 mo.		18 mo.	
M1	PC_C	1.70	22.08	9.30	157.63	9.00	98.90
	C_P	6.00	63.83	14.20	93.42	9.00	49.72
M1 R1	PC_C	9.20	213.95	9.90	90.83	11.64	84.35
	C_P	15.10	111.85	6.50	31.25	9.66	37.97
M2	PC_C	6.20	140.91	10.50	262.50	4.00	35.09
	C_P	8.30	78.30	1.20	8.28	6.30	40.91
M1 R2	PC_C	4.50	58.44	6.80	70.83	9.40	75.81
	C_P	6.20	50.82	1.00	6.10	9.80	44.95
M3	PC_C	3.80	126.67	2.80	35.90	7.40	92.50
	C_P	11.10	163.24	16.90	159.43	10.80	70.13
M1 R3	PC_C	1.20	8.57	7.30	47.40	4.70	25.82
	C_P	10.90	71.71	2.90	12.78	11.30	49.34
M6	PC_C	8.20	110.81	5.30	51.46	8.80	80.00
	C_P	−4.70	−30.13	3.60	23.08	9.80	49.49
M1 R6	PC_C	−1.20	−11.54	4.60	45.54	2.10	12.28
	C_P	12.20	132.61	15.10	102.72	9.70	50.52
M1 R3 C3	PC_C	11.00	144.74	12.30	89.13	9.70	67.83
	C_P	14.20	76.34	17.00	65.13	11.30	47.08
M1 R3 L3	PC_C	1.80	20.69	−3.80	−26.95	−2.70	−18.75
	C_P	7.20	68.57	13.20	128.16	9.90	84.62
Control	PC_C	7.10	116.39	13.50	287.23	13.20	176.00
	C_P	10.10	76.52	10.80	59.34	10.90	52.66
Mean	PC_C	4.86	86.5	7.14	101.1	7.0	66.4
Mean	C_P	8.8	78.5	9.3	62.7	9.9	52.5

(percentage point difference) and the relative differences (the percent difference) between those in PC and C at baseline and those in C and P. Sixty-two out of the 66 comparisons (94%) are in the predicted direction; i.e., those in PC had quit less than those in C who quit less than those in P at 6, 12, and 18 months.

Table 2 also presents mean absolute differences between PC and C and C and P across the 11 groups at each of the follow-ups. Baseline stage was predicting effects that were of comparable size at 6, 12, and 18 months. The stage effect for smokers in C compared to PC were 4.9, 7.1, and 7.0 percentage points at 6, 12, and 18 months, respectively. Similarly the stage effect for smokers in P compared to C at baseline were 8.8, 9.3, and 9.9 at 6, 12, and 18 months, respectively. The average stage effect across all follow-ups was 6.33 for PC versus C and 9.33 for P versus C. The relative differences were somewhat smaller at 18 months than at 6 and 12 months, but the differences were not significant. Specifically, smokers in C at baseline compared to those in PC had quit rates that were 86.5%, 101.1%, and 66.4% greater at 6, 12, and 18 months. Similarly, smokers in P compared to C had quit rates that were 78.5%, 62.7%, and 52.5% higher at 6, 12, and 18 months, respectively. The average relative difference across all follow-ups was 84.6% for C versus PC and 64.4% for P versus C.

Using absolute differences, the stage effects comparing PC and C were significantly smaller than the stage effects comparing C to P at each follow-up. Using relative differences, the opposite pattern held that the stage effects for PC to C were relatively greater than the stage effects for C to P at each follow-up. Across all groups and all follow-ups, the grand mean for the stage effects based on absolute difference was 7.8%. The mean percentage difference was 74%.

4. Discussion

These results indicate that stage effects predicted by the TTM have considerable consistency, stability, and size. In terms of consistency, 94% of the stage effects (62 of 66) were in the predicted direction with smokers in earlier stages at baseline having less abstinence at follow-up. This consistency held even though the treatment conditions varied from no treatment to single mailed manuals to manuals plus six expert system reports and expert system guides plus telephone counselors or nicotine-fading computers. This consistency also held even though the predictions varied from 6 to 12 to 18 months.

The stability of the stage effects was reflected by the fact that the absolute differences in cessation between an earlier and later stage were comparable at 6, 12, and 18 months after baseline. These results indicate that single-staging algorithms can predict cessation stability over time. These predictions are stable regardless of the two baseline stages being compared.

The average size of the stage effects based on absolute differences (7.8 percentage points) is comparable to treatment effects that we have found between the best population cessation treatments and proactive assessment alone [mean difference of 7.6 percentage points across five population cessation studies (Prochaska & Velicer, 2003)]. The average size of stage effects based on relative difference (74%) is even more striking. This effect indicates that smokers in contemplation at baseline will have about 3/4 more abstinence at long-term

follow-up than smokers in precontemplation. Smokers starting in preparation would have three times more abstinence on average than those starting in precontemplation.

These results suggest that brief stage-matched interventions that help populations progress one stage could produce 75% more abstinence. Interventions that help populations progress two stages could produce 300% more abstinence. Given that in the United States over 80% of smokers are typically in the precontemplation or contemplation stages, the practical public health impacts of interventions producing such progress could be substantial. In nations like Germany where only about 5% of smokers are typically in the preparation stage, the impacts of stage progression and stage effects could be even greater.

These results also support the importance of replicating stage effects across treatment conditions and over time. Farkas et al. (1996) found stage effects missing for one treatment condition at one time point and concluded that that was evidence to reject TTM in favor of a set of addiction variables. The current data suggest that the Farkas et al. results may simply have been 1 of the 6 in 100 times when a stage effect is not in evidence.

What might keep a stage effect from emerging? Here we can only speculate. Two of the four conditions without a stage effect were with precontemplation smokers compared to contemplation smokers at 12 and 18 months for the expert system plus nicotine-fading computers. The nicotine-fading computers are action-oriented treatment that would be most appropriate for smokers prepared to quit. We purposefully did not provide this action treatment to smokers in precontemplation because of concerns that it could produce an iatrogenic effect, i.e., produce worse outcomes because of pressuring people to take action who are not prepared. It is possible that such an iatrogenic effect was produced for smokers in the contemplation stage since over the long-term they had abstinence rates that were worse than smokers in the precontemplation stage who did not receive this action aid. This speculation would support the strategy of setting realistic goals with smokers at each stage rather than trying to pressure all smokers to take immediate action.

Acknowledgements

This research was supported by Grants CA 50087 and CA 27821 from the National Cancer Institute.

References

Farkas, A. J., Pierce, J. P., Zhu, S. H., Rosbrook, B., Gilpin, E. A., Berry, C., & Kaplan, R. M. (1996). Addiction versus stages of change models in predicting smoking cessation. *Addiction, 91*, 1271–1280.

Gritz, E., Car, C., & Chong, C. (1992). *Quality of life and smoking cessation in head and neck patients*. Presented at 16th Annual Meeting of American Society of Preventive Oncology Bethesda, MD.

Ockene, J., Kristeller, J. L., Goldberg, R., Okene, I., Merriam, P., & Barrett, S. (1992). Smoking cessation and severity of disease: The coronary artery smoking intervention study. *Health Psychology, 11*, 119–126.

Prochaska, J. O., DiClemente, C. C., & Norcross, J. C. (1992). In search of how people change: Applications to the addictive behaviors. *American Psychologist, 47*, 1102–1114.

Prochaska, J. O., & Velicer, W. F. (2003). *Treatment effect sizes across five stage-based population trials for smoking cessation*. Manuscript in preparation.

Prochaska, J. O., Velicer, W. F., Fava, J. L., Rossi, J. S., & Tsoh, J. Y. (2001). Evaluating a population-based recruitment approach and a stage-based expert system intervention for smoking cessation. *Addictive Behaviors, 26*, 583–602.

Prochaska, J. O., Velicer, W. F., Fava, J., Ruggiero, L., Laforge, R., & Rossi J. S. (2001). Counselor and stimulus control enhancements of a stage matched expert system for smokers in a managed care setting. *Preventive Medicine, 32*, 23–32.

Velicer, W. F., Fava, J. L., Prochaska, J. O., Abrams, D. B., Emmons, K. M., & Pierce, J. P. (1995). Distribution of smokers by stage in three representative samples. *Preventive Medicine, 24*, 401–411.

Velicer, W. F., Prochaska, J. O., Fava, J., Laforge, R., & Rossi, J. (1999). Interactive versus non-interactive and dose response relationships for stage matched smoking cessation programs in a managed care setting. *Health Psychology, 18*, 1–8.